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The following is a draft list of possible CALFED Stage 1 water quality measures that have been compiled based on input from stakeholders. These measures four kinds of operational changes: those that affect delta water quality for in-delta users, 2. Those that involve operations of the Projects to reduce salinity (TDS, bromide, chloride) and organics in water exported from the delta, 3, operational changes that would improve water quality of deliveries to urban contractors and 4. Transfers and exchanges to match water quality with relevant standards. Source control measures are taken up in other CALFED forums.

Any and all ties to water supply/environmental impacts should be highlighted in each description. A sharing formula for environmental, water supply and WQ needs to be worked out and it clearly applies to almost all the NoName Group tools so far collected.

I In-Delta water quality enhancement actions and possible impacts of proposed actions:

A. Hood diversion — This diversion could be operated only at times when the cross channel gates are closed. The 2,000 cfs may be adequate to protect/mitigate for in-delta water quality degradation that may occur when the cross channel gate is closed. At high outflow rates there may not be a water quality problem resulting from cross channel gate closure. MWD performed hydrodynamic modeling using the Fischer Delta Model to estimate the benefit of a 2,000 cfs diversion at Hood operating at times when the Delta Cross Channel is closed. WQ benefits were minimal but this measure could be used as a mitigation measure.

B. Clifton Court Forebay change in operations with new screens — Replacement of the
radial gates with a 6,000 cfs screen backed up by a low head pump to ensure constant approach velocities of .2 fps is likely to affect stage and quality of south delta water over the tidal cycle. What effects are likely? When exports exceed the permitted approach velocity for this screen, what are the WQ and stage impacts in the south delta of using the radial gates vs overdriving the screens?

C. VAMP expansion — Expansion of export restrictions and/or flow augmentations to protect a larger percentage of out-migrating salmon would affect WQ and stage in the south delta as well as later in the year (under some implementation scenarios). Are there NoName Group tools that would reduce adverse impacts of these actions on water quality? If recycled water from San Luis was used to augment San Joaquin flow would that affect delta WQ?

Comment: There is only slight water quality degradation at Banks (less than 5%) and Tracy (about 5-7%) with the VAMP expansion assuming the Old River barrier keeps most of the SJR water on the main stem. VAMP expansion (2 to 3 months), however, has major water supply impact.

D. Alex's recycling proposal —WQ impacts of this proposal could be large and diverse. Issues of the relative importance of the loading vs concentration of various WQ parameters in different parts of the San Joaquin River would be of interest to all CalFed parties. There may be major fishery concerns. If the additional flow is counted within the E/I constraint there could be a negative water supply impact.

II Improved water quality within-project:

A. San Luis operations: Shifting of exports to times of high flow — Present operation scenarios begin filling San Luis Reservoir before the onset of fall rains. This operation ensures the presence of low quality water in San Luis. X2 represents the upstream limit of saltwater intrusion, and the daily tidal cycles will bring bromide laden waters upstream about 5 km from the 14 day average location of X2. Thus, a simple operational and modeling parameter to improve delivered WQ would be to refrain from exporting water to storage until X2 is west of Collinsville. This restriction would also have biological benefits for species that live in the low salinity zone and out-migrating spring- run yearlings.

Deferring filling until outflow is higher, under present operating criteria, would increase the risk of not filling San Luis. Most of the tools recommended for further analysis in the NoName Report will tend to increase the likelihood of filling San Luis, thereby reducing the risk. A combination of limiting pumping to times of higher outflow, with the tools already described, could be balanced to reduce risk and improve export water quality, while protecting fish from the impacts of pumping at times of low flow.

Comment: Under current restrictions and ESA threats, the filling risk for water supply could be greater. The export quality benefits could be estimated with the G-model (very simple and accurate for sea-water intrusion to the Delta). Agricultural drainage on the SJR would need to be factored in. However, if the barriers are installed Tracy and Banks may have roughly the same quality and S. Delta quality may be buffered more from agricultural drainage. The next analysis step could quantify the level of mixing south of the pumps.

B. Adjusted minimum outflows in the fall: Minimum outflow could be boosted by 500 cfs or so in the fall. This could lower chlorides by about 50-70 mg/L in the South Delta.

C. Dumping bad water in wetter years — Water that is exported at times of poor delta water quality could be released into the San Joaquin River if delta water quality improves. This is a variation on Alex's recycling proposal but with a view to augmenting fish flows with water that might contain bromides so that there is room available to store water without bromides. Energy costs of pumping and releasing water might be offset by reduced treatment costs.

Notes: Probably worth analysis, but likely to cause some water supply cost and there are likely fisheries concerns with releasing Delta water into the San Joaquin River. Such an operation this year would likely have had a significant impact on delivered water qualtiy with no risk to supply.

As for fishery impacts of dumping bad water from San Luis if it starts to rain, yes there are concerns but those concerns may be reduced if flows are high (although the little data in hand suggest that it is still a serious concern, USGS data show 10 times as high a concentration (!) of organochlorine contaminants in the San Joaquin in wet conditions.

The cost of dumping low quality water from O'Neill would be reduced if that water was
released as part of the high value electric generation program (assuming that San Luis is used for peaking power generation). That is, we would release low quality water for power generation, then fill with higher quality water from the canals. The lower quality water would probably go into the DMC for delivery or discharge into the SJR. *This might require a lot of new plumbing to separate San Luis discharge* water from
incoming canal water (e.g., a new forebay). This technique could be used whenever San Luis water quality water is higher than the input canal water and doesn't even require dumping. It is a way to reduce salt mass loading out of San Luis without reference to net inflow or outflow.

D. San Luis dredging: There might also be water quality benefits accruing to San Luis through being able to get 100 TAF of sludge out of the bottom each Aug/Sept.

E. Utilization of Joint-Point for water quality: The CVP-Tracy export water is consistently lower in quality because of its plumbing limitations (Tracy draws directly from Old River throughout the tidal cycle, and therefore get more lower quality San Joaquin water which gets mixed with state water at O'Neill). The SWP operates CC forebay mostly on the higher tides, so it gets a slightly better mix of Sacramento River water. With unlimited joint-point flexibility, there are times when we could shift some of the CVP pumping over to Banks to achieve a better WQ at O'Neill without losing any water.

F: Central Delta intake: Gain access to higher quality water.

G. Delta Wetlands:
Delta Wetlands is the most advanced example of in-delta storage. Urban water users have voiced concerns about TOC problems with water from a flooded, unlined island. However, the proposed filling schedule for the projects ensures that there is little likelihood of bromides in the stored water. If this water can be kept isolated from bromide-contaminated waters in San Luis Reservoir, substantial improvements in reliability and WQ for urban users might be possible.

III. Improving quality of water to sensitive users.

A. Circumventing San Luis for urban deliveries when quality in SLR is relatively poor.

The plumbing operations at O'Neill and San Luis need to be looked at more carefully. Presently, without an O'Neill bypass we are unable to send higher quality water to joint reach of the California Aqueduct without mixing in O'Neill Forebay. The bypass could allow releases from SLR to be made to the lower DMC and to the Mendota Pool without mixing with higher quality Delta exports. Note that the joint reach also must deliver a substantial amount of agricultural water to Kern and WWD in addition to the large urban supplies in Southern California. Delivering water to urban outside the peak irrigation period is one way of further separating these supplies.

MWD deliveries — Notes: Probably should review earlier CALFED and Ag/Urban analysis of an O'neill bypass. Without a Hood diversion, the water quality differences between good and bad would be considerably less and we have the problem of significant Ag diversions south of the Delta that makes it tough to target water to the M&I users.

The timing of supply (high in winter) and demand (high in summer) would not allow MWD to completely circumvent San Luis even with Eastside Reservoir on line. However, the more MWD shifts the better. Smaller urbans living off of the California Aqueduct in SoCal beside MWD are a problem. Some of those urban contractors do not have local storage or ground water so it is difficult for them to shift demand.

Selective withdrawals from SLR could also help if an O'Neill bypass were built (for example, when quality in SLR was worse than the Delta pumps and both were being used for deliveries route the better quality into the joint reach of the CA and sent the lesser quality water into the lower DMC.

B. Enlarged Pacheco Reservoir:
If urban supplies bypass San Luis Reservoir this could be problematic for the Santa Clara Valley Water District, because the intake for their CVP urban supplies is on the west side of San Luis Reservoir. SCVWD would be stuck with poor quality water in San Luis (probably even poorer quality water than it is now) unless a connection from the CA is built to the San Felipe Division (about 10-15 miles of pipe at about 250-300 cfs). In order to maintain reliability for Santa Clara's urban supplies, the configuration could also include some amount of separate storage for higher quality water. One idea involves enlarging Pacheco Reservoir, located

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adjacent to the San Felipe system. In addition to providing a place to put higher quality water, it could have the additional benefit of helping to resolve the "low-point" problem at San Luis Reservoir. Currently, in order to keep Santa Clara's CVP urban supplies online in the summer months, San Luis storage has to be kept above 150,000 AF. If there was alternative storage, San Luis could potentially be dropped at least another 100,000 AF in the summer, resulting in greater storage potential/water supply benefits.

Pacheco Reservoir is a small (approximately 6,000 acre-feet) reservoir located west of San Luis Reservoir that captures local runoff from Pacheco Creek for local agricultural use. The reservoir is fairly close, though not currently connected, to the Pacheco Conduit, a San Felipe Division facility. This conduit currently delivers M&I and agricultural water from San Luis Reservoir to two CVP contractors, Santa Clara Valley Water District (SCVWD) and San Benito County Water District. Because of site constraints, "enlarging" the reservoir would most likely entail demolition of the existing dam, and construction of a new dam upstream. With a new dam height of 270 feet to 375 feet, the reservoir storage capacity ranges from 150 KAF to 400 KAF.

The additional storage in Pacheco would presumably also free up space that would otherwise be taken up in SLR so average deliveries could increase.

Other notes: The South Bay Aqueduct runs at near capacity year round (the contractors may be discussing an expansion). The SWP uses Del Valle for summer peaking of S. Bay Aqueduct deliveries. SCVWD's demand shift opportunities are limited because of limited local storage.

C. Restructured SCVWD intake.

Two ideas that have been voiced, but not investigated, have to do with modifying the intake in San Luis Reservoir to the San Felipe facilities. Because of the elevation of the intake, water quality is a concern when reservoir elevations reach 300 TAF. In addition, the full San Luis Reservoir capacity can not be utilized because the operational limit of the intake leaves a dead pool storage of 80 KAF in the reservoir.

One idea is to excavate around the intake, thereby making the water deeper at the inlet, and less hospitable to algae growth. However, operations staff believes that the algae growth has more to do with the depth of water above the inlet than below it. Most likely the inlet would have to be modified structurally if the area around it was excavated.

Another idea is to extend the inlet pipeline and build a new intake in a deeper part of the reservoir. This might improve water quality, and decrease dead pool storage in the reservoir.

D. Enlarged Los Vaqueros

The water quality benefits of storing drinking water in a separate facility south of the delta have been widely recognized. Enlargement of Los Vaqueros has already been given substantial planning effort, although analyses related to the water quality benefits to urbans (besides CCWD) are still preliminary. The design/construction/planning effort has identified environmental impacts that are probably only solvable through the kind of ESA consultation that CalFed is already using.

Results from the preliminary water quality analyses showed that quality gains to southern California were modest due to the mixing that occurs south of San Luis Reservoir. The gains begin to rise when SCVWD is connected more directly to the high quality reservoir (either through a Cal. Aqueduct-San Felipe Unit connection or an expansion of the So. Bay Aqueduct-direct connection to LVR project). It may be possible for MWD to benefit more if more of their demand is shifted into the winter. High quality water could be stored in LVR when it arrived in the Delta and sent south outside of the peak irrigation season. An enlarged LV could also provide ecosystem benefits because pumping could be immediately ceased while exports continued via out of LVR (gravity fed).

E. Demand shifts with Eastside:

The concept would be to save the high quality water in storage near the Delta when it arrived and then fill Eastside during the off-irrigation season when MWD has most of the Calif. Aqueduct to themselves. There are capacity limitations for this however. Edmonston PP, the east branch of the CA, and the inland feeder (which MWD will use to fill Eastside from the SWP side) are all check points. The inland feeder is rated at 1,000 to 1,500 cfs? There may be demand shift potential in the 800 TAF reservoir before buildout occurs. Smaller SoCal urbans may not be as flexible as MWD, however.

F. Existing LVR: Existing LVR would have limited (5-15 TAF) of water available for CALFED depending on operations and assurances. Connection with EBMUD conveyance facilities could ensure high-quality replenishing water if LVR releases were made for CALFED supply purposes.

IV Water Exchanges or Transfers for Water Quality

Pine Flat and Millerton reservoirs contain water of exceptional quality beyond any reliable level from the lower Sacramento River. They are connected to the State and Federal water supply systems via the San Joaquin river channel and the Cross Valley Canal. The proposed Mid Valley Canal and Arvin Edison projects could provide further water management connections. This water is free of bromide contamination and usually has negligible amounts of TOC. The quality of water

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from these sources is such that when used for dilution of water from other sources, a lower volume might be required.

To qualify as a part of a CalFed program, any use of these facilities to provide higher water quality for drinking water uses would have to have no significant redirected impacts on local agriculture.

Court actions are pending that are likely to reduce the yield of Millerton Reservoir as a step toward restoring riverine health. Changes in the point of use of this water will not alter future environmental responsibilities, which should be considered in calculations of future yield. Increased flows on the San Joaquin could be used to meet a variety of environmental goals described by ERPP and DEFT, in addition to riverine conditions. It would be best to negotiate a total package of environmental restoration needs of the San
Joaquin and the delta, with water quality protection to municipal users, and protection of supplies to local agriculture. CalFed is probably a good forum to address such a bundle of actions.

A. *Flood control options* —When water is released form Friant into the San Joaquin River channel to accommodate flood control needs, some water could be diverted into the cross valley canal and delivered into storage in the MWD service area, Eastside Reservoir, groundwater basins, etc. This water should reduce the quantity of water MWD required from the delta later in the year. (Note: The SWP already operates this way).

Most any time there is water released from Friant, other Eastside streams and the Delta would also have surplus flows and the limitation would be conveyance, recharge and storage intake capacities. SJ Valley groundwater recharge would already be maximized and Delta flows would also be high, with generally good water quality. We could (and should) look at this, but I don't think there is much potential beyond what already is occurring.

B. Dry year options —When delta water quality is seriously degraded due to very low inflows, options might be exercised to purchase water and transport it for delivery to MWD. If these options targeted rare hydrological conditions, than third party impacts might be no worse than found in normal agricultural operations. If the options targeted more frequent hydrodynamic conditions, the exercise of the options could be conditioned upon providing an equivalent volume of water from the delta to agriculture

Comment: MWD is already assuming water transfers in its IRP in dry years. Depending on where the water is coming from, water quality may or may not improve. If the water has to go through the Delta then the mixing will still occur.

This, and the others below, start to raise redirected impacts issues. There is also the issue of how much water would be available.

C. Permanent trades —Development of a Mid Valley Canal or other physical facility to deliver delta water to the Friant Water Users could enable frequent trading of high quality drinking water in exchange for monetary considerations and guaranteed delivery of suitable water for agricultural uses. Permanent trades could also be facilitated through improved water use efficiency or changes in cropping patterns.

One the plus side, in addition to the direct exchange benefits, availability of a Mid Valley Canal should open up a huge amount of groundwater storage potential, likely more than 1 MAF. The problem here would be with the water quality implications of the trades. The Tulare Basin already has an adverse salt balance and will eventually (several generations from now) be rendered unusable without removal of salts. While the focus in the Tulare Basin has been on water supply, you would be substituting higher salinity water for good quality water from local users on the Eastside that have nothing to do with the Delta. I suspect you could get some people interested in an unbalanced swap (say 1.5 to 1) of Delta water for local water, with money compensation, but other local people would raise legitimate concerns about the long-term water quality implications. This concept would redirect impacts to increase salinity in the San Joaquin Valley. There would also be inequities as groundwater degradation would result to users generally, not just the ones that get compensated for any direct exchange.

D. Arvin Edison in lieu uses —MWD contract water from the delta could be stored in ground water basins for use by local users to enable the delivery of Millerton and Pine Flat water at other times to MWD.

As a water supply tool this is already in the package. This is another tradeoff question. Do we use limited SOD groundwater storage for water supply or water quality?
Also note that MWD is not the only urban exporter, though we are the largest. In fact, MWD probably has more flexibility than other, so we cannot neglect the needs of other exporters, both SWP and CVP.

Limitations on water quality measures: Generally speaking, in dry years there may be limited opportunities to move water around for quality enhancement for urbans with the given infrastructure if supply is not to be risked. Timing of transfers could be optimized for quality, though (capacity would be available).

V Miscellaneous (some overlap with above)

A. Demand shifting: Can MWD shift as much delivery as possible out of the peak irrigation period when their water mixes with WWD and KCWD deliveries. Can

SCVWD shift their demand through the use of internal SCVWD storage or GW *conjunctive use?*

B. Exchanges:

Bruce's Friant-exchange idea (Eastern Sierra water from Kern-Friant area provided to southern California urban areas in exchange for California Aqueduct water)

Other CVPIA exchanges proposed in 1997.

NHI is working on the feasibility of rewatering the SJR through a series of exchanges. Increased flows in the river would presumably reduce concentrations of pollutants in the south Delta.

CCSF/SCVWD/Tuolumne River/West-side SJR diverter: The concept would be to deliver high-quality water to SCVWD through existing CCSF conveyance and intertie with SCVWD service area near the Bay Area. SCVWD would exchange CVP water for .....Water delivered to Exchanged *water would be the* Tuolumne obligation for Vernalis flow requirements (still underdetermined, per the SWRCB WQCP hearings)

C. Bifurcating the California Aqueduct south of San Luis Reservoir to segregate urban and ag supplies south of the Delta.

D. Multi-plexing of water through the California Aqueduct (alternating high- and low-quality water deliveries to urban and agricultural contractors, respectively).

TOC production related to habitat: Must consider the TOC implications of new tidal habitat. USGS work seems to indicate that the new habitat will increase TOC outputs into the water body. This may make it more important to minimize bromides in water delivered from the delta.

E. Desalination: The cost of desalination is related to the salinity differentials desired. Options include desalination of water that is relatively low in salinity. Use of low pressure membranes? The salt could be rejected right at Clifton Court, however, some sort of drain may be need *to deposit salts where they will do little* harm and will not be recycled.

F. Organic reduction of TOC: Use of biological systems to harvest organics (TOC)? Need to investigate if THM precursers are consumed by any organism Zooplankton? A major concern would be plumbing problems with the existing conveyance system. Corbicula used to be a substantial problem in the canals, could these clams be used to filter TOC from San Luis or elsewhere?

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